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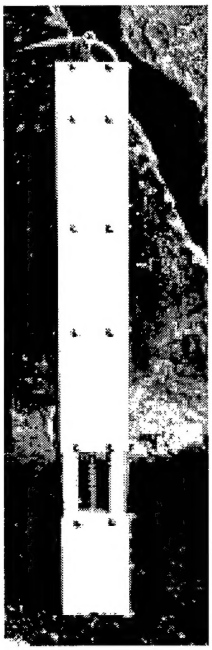
Controlling Zebra Mussels, Quagga Mussels, and Biofilm Growth with the Plasma Sparker

BACKGROUND AND PURPOSE: A plasma sparker has been developed by Sparktec Environmental, Inc., to control zebra mussels (*Dreissena polymorpha*) and quagga mussels (*Dreissena bugensis*). The device produces a plasma pulse, which is a physical, nonchemical, nonthermal process that introduces energy directly into an aqueous solution. When the plasma sparker is activated, electrical energy stored by capacitors is released in microseconds between two submersed electrodes. A plasma channel is formed because of this high current/high voltage electrical discharge. The discharge process consists of at least three primary events: an intense shockwave, a steam bubble that may lead to a supercritical water phase where oxidation of organic substrates occurs, and ultraviolet light production. This patented system is made up of three separate components, a power supply to control the power management, a capacitor storage bank to store the required energy, and a submersible assembly where this energy is released to the water.



Sparktec Plasma Sparker

Mackie, Lowry, and Cooper (2000) reported on results of laboratory experiments and a field demonstration of the Sparktec Plasma Sparker (sparker) in the forebay at Nanticoke Thermal Generating Station (NTGS), Lake Erie. The device was effective at retarding zebra mussel growth, increasing existing zebra mussel mortality, and reducing the growth of biofilm. Welch et al. (2000) measured the strength of the acoustic pulse of the sparker in the laboratory. They found that: (a) Increasing the charge voltage of the sparker by 80 percent increased the water shock amplitude by about 40 percent, with negligible increase in water shock pulse duration; (b) Increasing the capacitance of the charging circuit by a factor of 3 had negligible effect on the induced water shock at high (9-KV) charging voltages, but significantly increased (by a factor of 5) the water shock amplitudes at low (5-KV) charging voltages; (c) Increasing the sparker electrode gap from 1.1 mm to 4.2 mm doubled the water shock amplitudes, and increased the water shock pulse durations; and, (d) Use of a steel reflecting plate and cylindrical steel waveguide significantly increased (factor of 3) the water shock amplitude near the exit point of the waveguide.

The purpose of this technical note is to provide practical information on controlling zebra mussels, quagga mussels, and biofilm with the Sparktec sparker. This technical note lists locations where the sparker has been used, as well as estimated costs and maintenance requirements.

USE OF THE SPARKER: The technology is currently in use in the following utilities and industries in Canada and the United States:

a. Vergennes Panton Water District, Vergennes, Vermont.
b. Georgia-Pacific Corporation, Plattsburgh, New York.

c. Village of Rouses Point, Rouses Point, New York.
d. Lagoon City, Township of Ramara, Simcoe County, Ontario.

DEPLOYMENT OF THE SPARKTEC SPARKER: In each of the above locations, with the exception of the Rouses Point installation, the sparkers have been installed in the wetwell with the submersible assembly directed into the pipeline, and energy has been forced down inside the pipeline. The Village of Rouses Point does not have a wetwell, so the submersible assembly was installed directly into the pipeline.

Site	Location	Length	Diameter	Date Installed
Vergennes, VT	Wetwell	1800'	16"	July 1994
Plattsburgh, NY	Wetwell	492'	30"	May 1997
Lagoon City, ON	Wetwell	1400'	12"	April 1998
Rouses Point, NY	In-line	1300"	16"	May 1999

ESTIMATED COST: The cost to purchase one plasma sparker is approximately $40,000.00 US. Leasing and lease-to-own options are also available. The operating costs based on a 30-sec discharge frequency can range from $60.00 - $170.00/year. Energy costs increase depending upon the diameter and length of the intake pipeline. A larger pipeline will require a higher voltage level and therefore energy consumption will increase.

Installation costs of the sparker can vary depending on the location. Each installation is different and many plants and plant operators can accomplish this task without hiring an outside contractor. The time required to install the sparker is minimal and installation can often be accomplished in less than one day.

MAINTENANCE REQUIREMENTS: Steel electrodes are the only consumable parts that require regular replacement and they should be replaced at 8-week intervals. The cost of each set of electrodes is approximately $30.00 and this task can easily be completed by industrial or municipal plant employees. The equipment has been designed for ease of installation and maintenance.

Once per year, the three components (capacitor bank, power supply, and submersible assembly) should be inspected and cleaned. Maintenance should take approximately 4 hr and should be completed by the manufacturer or a designated high voltage technician.

SUMMARY: No single method can be used to control zebra mussels under all conditions. The Sparktec sparker is an environmentally benign control method suitable for reducing or eliminating adults and settlement of young zebra mussels in pipes or other confined areas. A single device would not be used for total zebra mussel removal in open areas such as a large forebay, a large holding tank, lake, or pond. Multiple devices could be considered for large forebays or large holding tanks, but would not be suitable for lakes or large ponds. The device requires minimal maintenance and is inexpensive, especially if there is concern over the environmental effects of chemicals.

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> Miller, A. C. and Lowry, P. (2000). "Controlling zebra mussels, quagga mussels, and biofilm growth with the plasma sparker," *Zebra Mussel Technical Notes Collection* (ERDC TN-ZMR-2-23), U.S. Army Engineer Research and Development Center, Vicksburg, MS. *www.wes.army.mil/el/elpubs/zebtnote.html*

REFERENCES

Mackie, G. L., Lowry P., and Cooper, C. (2000). "Use of plasma pulse technology for controlling zebra mussel settlement," *Zebra Mussel Technical Notes Collection* (ERDC TN-ZMR-X-XX), U.S. Army Engineer Research and Development Center, Vicksburg, MS.

Welch, C. R., Johnson, J. W., Blake, H., Miller, A. C., Dardeau, E. A., Jr., Cooper, C., Eng, E., and Lowry, P. (2000). "Water shock pressure fields generated by the Sparktec plasma sparker," *Zebra Mussel Technical Notes Collection* (ERDC TN-ZMR-X-XX), U.S. Army Engineer Research and Development Center, Vicksburg, MS.